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Seagrass and Caulerpa Monitoring in Hillsborough Bay Eighth Annual Report

City of Tampa Department of Sanitary Sewers

SEAGRASS AND *CAULERPA* MONITORING IN HILLSBOROUGH BAY
EIGHTH ANNUAL REPORT

SUBMITTED TO

THE FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

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CITY OF TAMPA

DEPARTMENT OF SANITARY SEWERS

BAY STUDY GROUP

EXECUTIVE SUMMARY

The City of Tampa, Bay Study Group has been monitoring water quality in Hillsborough Bay since 1976 and has documented improvements in several water quality parameters since the early 1980's. The improvements in water quality were followed by the emergence of shoalgrass, *Halodule wrightii*, in several areas of Hillsborough Bay.

The Bay Study Group began a monitoring program in 1986 of the seagrasses *H. wrightii* and *Ruppia maritima*, and the alga, *Caulerpa prolifera*. The purpose of the study was to monitor changes in seagrass coverage, because seagrass may serve as an indicator of water quality. However, the study is not intended to link the discharge from the Howard F. Curren Advanced Wastewater Treatment Plant with changes in the seagrass community. *H. wrightii* baywide areal coverage was about 2,000m^2 in the initial survey in 1986 and has now increased to about 40.4ha. Coverage for *R. maritima* had fluctuated between 0.2ha and 2.2ha between 1986 and 1995. However, in the spring of 1996, *R. maritima* coverage expanded to about 40ha. *C. prolifera* coverage has varied greatly over the study period. After reaching maximum coverage of 280ha in 1988, *C. prolifera* meadows were reduced nearly an order of magnitude following a "25 year" rainfall event in the fall of 1988. In 1996, *C. prolifera* coverage was less than 0.1ha in Hillsborough Bay.

Seagrass recolonization is occurring in the intertidal and subtidal areas of Hillsborough Bay apparently in response to improved water quality. Sizeable *H. wrightii* meadows are now established in southeastern Hillsborough Bay and along Interbay peninsula in western Hillsborough Bay.

INTRODUCTION

The City of Tampa, Bay Study Group (BSG), created in 1976, has monitored the effects of pollution abatement in Hillsborough Bay since 1979. During the mid 1980's, water quality improvements and evidence of minor seagrass revegetation in Hillsborough Bay prompted the BSG to initiate a seagrass study to compliment other programs assessing the environmental status of Hillsborough Bay.

Documentation of submerged aquatic vegetation (SAV) began in April 1986 with a thorough groundtruthing effort which located and described *Halodule wrightii*, *Ruppia maritima* and the attached benthic alga, *Caulerpa prolifera*. Seven additional intensive groundtruthing efforts to document *H. wrightii* were completed in 1989 and 1991-1996, all during the month of October. In addition, study sites were established for *H. wrightii*, *R. maritima* and *C. prolifera*, however, monitoring of *R. maritima* and *C. prolifera* at specific study sites has been discontinued. Generally, study sites are monitored three times a year.

In 1996, the BSG established thirteen seagrass transects in anticipation of a proposed Tampa Bay seagrass monitoring program coordinated by the Tampa Bay National Estuary Program (TBNEP) and the Southwest Florida Water Management District's Surface Water Improvement Program(SWIM). The monitoring program would be a part of the Comprehensive Conservation and Management Plan produced by TBNEP. This plan aims to restore and protect Tampa Bay seagrass meadows principally through the management of nitrogen discharges to the bay. The BSG will be one of several agencies involved in the seagrass monitoring program presented in this plan. Participation in this program may result in further changes to the BSG seagrass monitoring in the future.

The BSG transplanted *H. wrightii* into Hillsborough Bay in 1987 and 1989. Monitoring of *H. wrightii* transplants in Hillsborough Bay has been discontinued due to coalition with naturally occurring coverage. Data for transplants were included in the reports submitted through 1994. Transplant coverage is now included as part of the baywide *H. wrightii* areal coverage estimate.

The purpose of the BSG seagrass program is to monitor changes of SAV, excluding drift macroalgae, in Hillsborough Bay. Seagrass is an important Tampa Bay habitat and may serve as an indicator of water quality. However, the seagrass program is not intended to link the discharge from the Howard F. Curren Advanced Wastewater Treatment Plant with changes in the seagrass community.

This is the seventh annual report submitted to the Florida Department of Environmental Protection (FDEP) to satisfy the requirements set forth in specific condition #14 of FDEP operation permit D029-1845321B.

METHODS

The BSG seagrass program has been modified several times since 1986. The report, "An Ongoing Survey of *Halodule wrightii, Ruppia maritima*, and the Alga, *Caulerpa prolifera* in Hillsborough Bay, Florida: Initial Assessment and Design" describes study site locations and experimental design for the naturally occurring seagrass and *C. prolifera* projects through the 1991 spring survey. It does not, however, contain seagrass transplant information and project modifications made after the 1991 spring survey. Transplant information and methods used to evaluate SAV during 1991, 1992, and 1993 are discussed in the annual report submitted to DEP in March, 1994.

Seagrass coverage in an embayment east of the north end of Apollo Beach (Figure 1), had been included in reports after 1989. It is unclear if this area should be included within the boundary of Hillsborough Bay, however, the BSG decided to omit this area as part of the study. Therefore, Hillsborough Bay seagrass estimates reported after 1989 were revised in the sixth annual report to FDEP submitted on March 1, 1995.

STUDY SITES

Halodule wrightii

The intertidal and shallow subtidal flats of Hillsborough Bay were divided into thirteen areas (Figure 1). Within each area, one patch of *H. wrightii*, if present, was chosen for study at a depth of 20-30cm below mean low water. An additional patch was added on the deeper portion of the bar if the location was deeper than 80cm below mean low water. Two of the original study sites, B-1 and K-5, have been retained as shallow study sites.

Each study site is evaluated on a seasonal basis. During each visit to a study site, short shoot density, blades per short shoot, and blade length are measured. Short shoot density is determined using a $100cm^2$ square. Blade length (emergence from the short shoot basal stalk to tip of the blade) is measured to the nearest centimeter. Subjective evaluations concerning epiphytes and seagrass health are recorded. Epiphytic cover is rated as clean, light, moderate, or heavy. Seagrass appearance is rated as poor, fair, good, or very good. Salinity, temperature, and depth are recorded.

Ruppia maritima

One *R. maritima* transect was established in western Hillsborough Bay in 1987 and discontinued in 1992. Currently, data on *R. maritima* is collected during seasonal visits to the thirteen subdivisions in Hillsborough Bay. *R. maritima* patches are selected at random and measurements of blade length, short shoot density, and inflorescence, if present, are taken. Short shoot density is determined with a 10x10cm square.

Caulerpa prolifera

Five *C. prolifera* transects (Figure 2) in Hillsborough Bay were visited seasonally through the fall of 1994. However, due to the paucity of *C. prolifera* in Hillsborough Bay, the BSG discontinued detailed investigation of these five transects pending the return of significant *C. prolifera* coverage. In the interim, data will only be collected where the alga is present. Data from five randomly tossed 1x1m squares will include: percent *C. prolifera* coverage, frond density and length, percent drift macroalgae cover, the number of the polychaete, *Diopatra cupraea*, depth, temperature, and salinity. Data describing transect coverage through 1994 may be found in the 1995 report.

TBNEP/SWIM Transects

Thirteen transects were established in the fall 1996 in order to follow spatial and temporal seagrass trends (Figure 3). Eleven transects are in Hillsborough Bay and two in Middle Tampa Bay. Six of these transects traverse SWIM seagrass study sites. The methodology to be employed for data collection along these transects is still being discussed, however, a baywide monitoring plan should be in place by the end of 1997.

AREAL COVERAGE

Areal coverage for *H. wrightii*, *R. maritima*, and *C. prolifera* is estimated with high altitude (ca. 6,000ft.) aerial photographs taken in the fall from a fixed wing aircraft. After a scale is determined for each photograph, a grid composed of 1x1mm squares is placed over the photograph. The number of $1mm^2$ squares covering a SAV signature in the photograph are counted and the areal extent of the SAV is determined by multiplying the number of squares counted times the scale determined for a square. All SAV is groundtruthed within four weeks of the overflight.

Some areas of Hillsborough Bay do not have sufficient SAV coverage to produce a signature on the high altitude photograph. These areas are visited within four weeks of the overflight and any SAV encountered is documented. The major and minor axes for each *H. wrightii* patch is measured and the area determined using the formula for an ellipse. Areal coverage of *R. maritima* and *C. prolifera* is determined by estimating the percent cover of each species in an area of a known acreage.

RESULTS AND DISCUSSION

Halodule wrightii

Halodule wrightii coverage described in Hillsborough Bay for 1991, 1992, and 1993 has been revised, due to the change of bay area definition, to 2.0ha, 5.2ha and 7.3ha respectively, nearly thirty percent below coverage reported for each year.

H. wrightii coverage for the northeastern, southeastern, northwestern, and southwestern portions of Hillsborough Bay is illustrated in figures 4, 5 ,6, and 7, respectively. These figures are intended to present the general areal extent for *H. wrightii* and are not used for the calculation of areal coverage reported in this document.

H. wrightii coverage in Hillsborough Bay increased over 40 percent from 28ha reported in 1995 to about 40.4ha in 1996 (Figure 8). Area 2, in southeastern Hillsborough Bay (Figure 1), registered the greatest increase in coverage, gaining nearly 13ha (Figure 9). The other areas of Hillsborough Bay had only a modest increase in coverage or, as in areas 11 and 12, a reduction in coverage. Coverage in these two areas had increased substantially from 1994 to 1995. However, in 1996, coverage in area 11 decreased about 35 percent to 1.5ha (Figure 10). Similarly, coverage in area 12 decreased about 45 percent to 1.1ha (Figure 11). Coverage in areas 9 and 10 increased to 1.1ha and 6ha, respectively (Figures 12 and 13). Area 3 has began to develop numerous *H. wrightii* patches between the Kitchen and Bullfrog Creek. Coverage in this area, estimated at 4500m^2 in 1996 (Figure 14), should rapidly increase within the next few years as the patches coalesce. Coverage in areas 1,4,5, and 13 (Figures 15, 16, 17, and 18)increased slightly in 1996. Finally, several *H. wrightii* patches were noted in area 8, nearly three miles north of Ballast Point and the coverage was estimated at about 10m^2 (Figure 19). This was maybe the first seagrass observed in this portion of Hillsborough Bay in thirty-five years. *H. wrightii* coverage in each area during 1986, 1989, and 1991-1996 is presented in Table 1.

Ruppia maritima

R. maritima persists in several areas of Hillsborough Bay, however, the areal extent may vary greatly on an annual basis. Between 1986 and 1995, coverage fluxuated between 0.2ha and 2.2ha. However, in the early spring of 1996, dense stands of *R. maritima* began to develop in the northeastern portion of the Kitchen, between Pendola Point and the Alafia River(particularly near Archie Creek) and, in southeastern McKay Bay. Coverage attained 10ha in the Kitchen, 23ha between Pendola Point and the Alafia River and 6ha in McKay Bay. In addition, scattered coverage was found along eastern Interbay peninsula and between Gadsden Point west to the Macdill AFB marina. About 40ha of *R. maritima* were found in Hillsborough Bay in 1996.

Table 1. *Halodule wrightii* coverage (m^2) by area in Hillsborough Bay for the years 1986, 1989, and 1991-1996.

	1986	1989	1991	1992	1993	1994	1995	1996
AREA								
1	690	700	400	500	2000	2630	2500	3000
2	1125	3300	16300	40801	34000	135000	167000	296000
3	0	0	40	350	250	1200	2500	4500
4	0	0	200	475	500	600	500	1000
5	0	0	15	150	600	1200	750	1500
6	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	10
9	85	140	800	1900	7000	10400	8700	11000
10	40	750	1600	6750	22400	32400	54000	60000
11	0	65	200	650	5000	10500	28500	15000
12	20	20	20	250	1300	2800	17000	11000
13	0	0	0	0	30	100	400	500
TOTAL	1960	4975	19575	51825	73080	196830	281850	403510

Caulerpa prolifera

C. prolifera has been observed in four general areas of Hillsborough Bay: 1) along southeastern Interbay Peninsula; 2) near Ballast Point; 3) between Pendola Point and the Alafia River; and 4) along Davis Island.

C. prolifera in Hillsborough Bay has exhibited both rapid increase and rapid loss in coverage since monitoring began in 1986. For example, in 1986, between April and December, a 40 fold increase in coverage to 200ha was documented in western Hillsborough Bay. A 90 percent reduction in coverage occurred in the fall of 1988 immediately following a "25 year" rainfall event which lowered salinities to 2ppt in some parts of Hillsborough Bay. The decline of *C. prolifera* in that area is probably a result of extended exposure to unusually hyposaline conditions. Similarly, in an area south of Pendola Point, the alga expanded from 0.8ha in 1987 to 190ha in 1990. Following this maxima, coverage has steadily declined. However, a causative event cannot be singled out for the decline of the alga in this area.

Three major areas of *C. prolifera* coverage were reported in 1994: 1) between Gadsden Point and the marina on the south end of Macdill AFB (25ha), 2) Ballast Point (1ha), and 3) south of Pendola Point (3ha). Coverage in Hillsborough Bay for 1995 rapidly declined to less than 2000m^2 with scattered coverage observed in each of the three areas. However, in 1996, no coverage was observed around Ballast Point or Pendola Point. Sparse coverage was observed just east of Gadsden Point. In 1996, *C. prolifera* coverage in Hillsborough Bay was less than 1000m^2.

C. prolifera presence followed by its disappearance has been documented in other areas of Hillsborough Bay. Sparse *C. prolifera* was found along southeastern Davis Island from 1986-1989 and on the western end of Bird Island (Figure 1) from 1993-1994.

In summary, *C. prolifera* has rapidly colonized large intertidal and subtidal areas of Hillsborough Bay since 1986. Furthermore, this alga appears to be sensitive to low salinity for extended periods. Overall coverage was estimated at less than 0.2ha in the fall of 1995.

CONCLUSION

Improving water quality in Hillsborough Bay has allowed recolonization of *H. wrightii* into many intertidal and subtidal areas of Hillsborough Bay. A majority of the *H. wrightii* renewal has occurred in the Kitchen, although development and coalition of *H. wrightii* patches have created sizable meadows in the western and northwestern sections of the bay. However, some of the coverage around Macdill AFB declined, possibly in response to high drift macroalgae biomass over the seagrass. In 1996, patchy *H. wrightii* coverage was rapidly developing on the flats north of the Kitchen and the seagrass in this area should coalesce into a major seagrass meadow within a few years. Finally, patchy coverage has continued to develop slowly between Pendola Point and the Alafia River.

Some areas of Hillsborough Bay have *R. maritima* meadows which can vary in size from year to year. In recent years, this species had become a minor component of the total seagrass coverage in Hillsborough Bay. However, in 1996, *R. maritima* coverage in Hillsborough increased to about 40ha, equaling the amount reported for *H. wrightii*.

C. prolifera has been a major contributor to SAV coverage in the past decade. This alga has been observed growing in deeper waters than *H. wrightii*, indicating that the alga may be a pioneer species in areas with relatively low light penetration. *C. prolifera* can vegetate large areas in a short period of time and, conversely, undergo sudden, large scale, die-offs. For example, loss of *C. prolifera* meadows in western Hillsborough Bay occurred immediately following exposure to unusually low salinities for an extended period in 1988. In other areas, reductions in areal coverage do not appear to be salinity related and may occur more gradually.

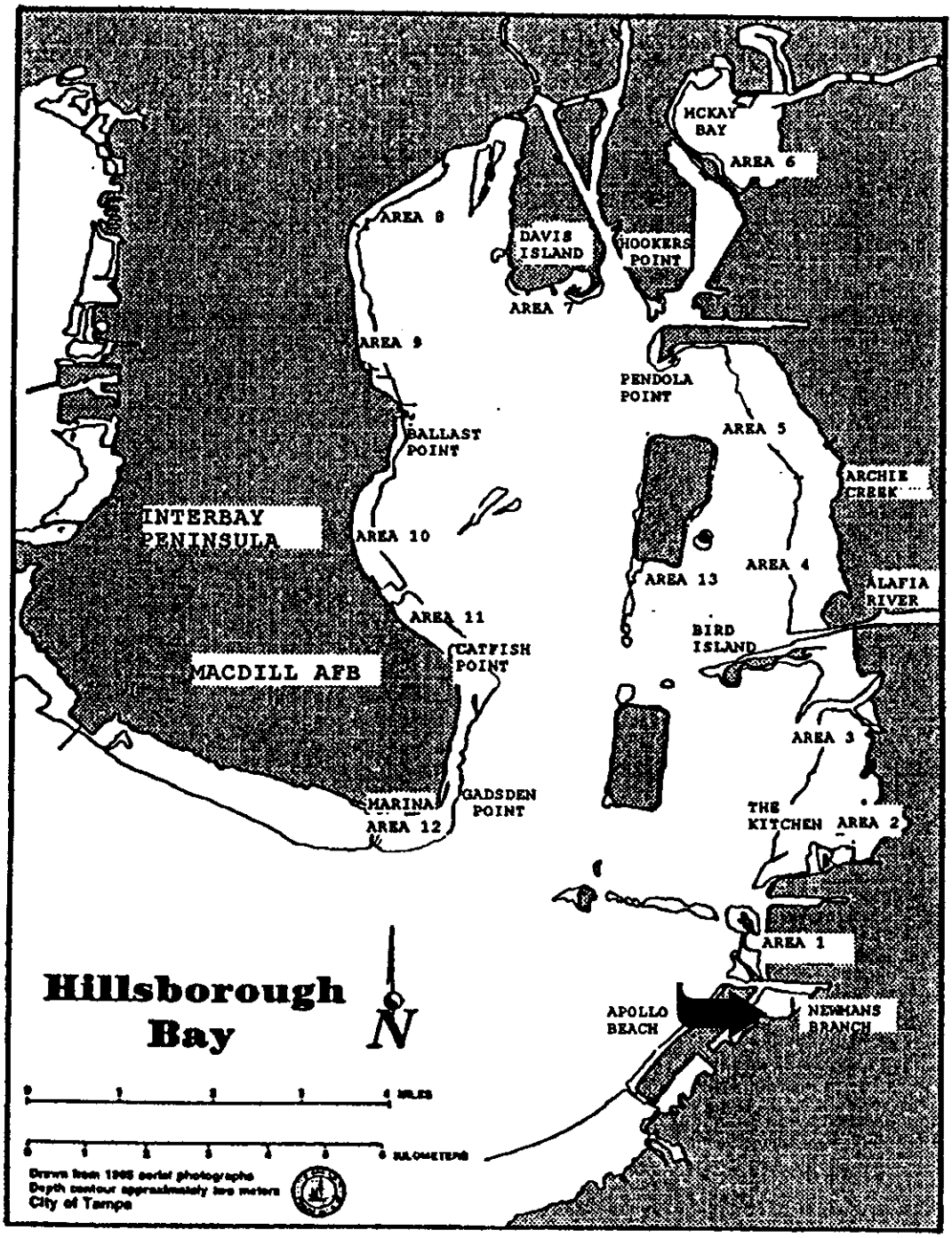

Figure 1. Location of the thirteen *Halodule wrightii* study areas in Hillsborough Bay. Arrow indicates embayment previously included as part of Hillsborough Bay.

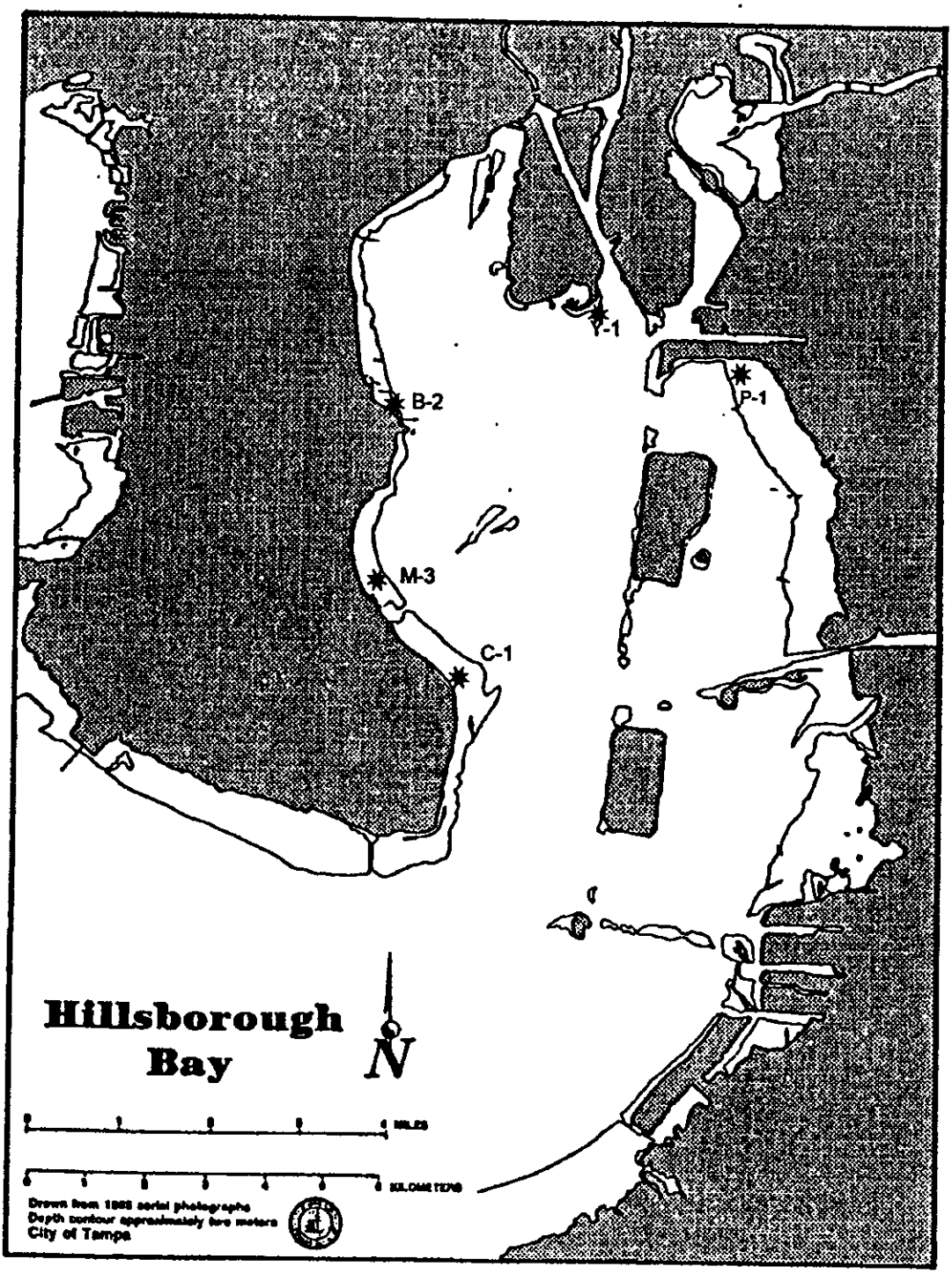

Figure 2. Location of the five *Caulerpa prolifera* transects (✱): B-2, C-1, M-3, P-1, and Y-1.

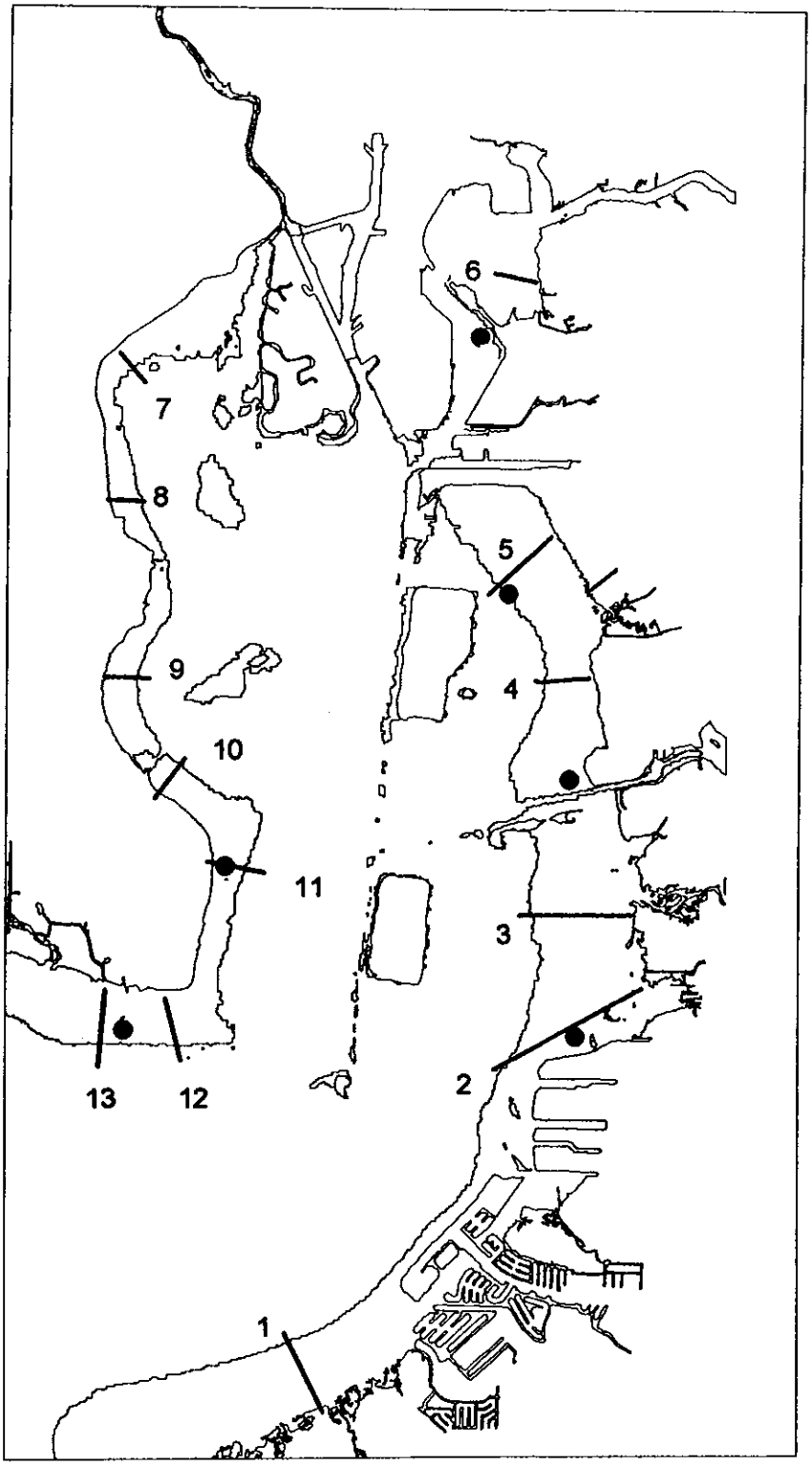

Figure 3. Location of the thirteen seagrass transects and the SWIM study sites (●) in Hillsborough Bay.

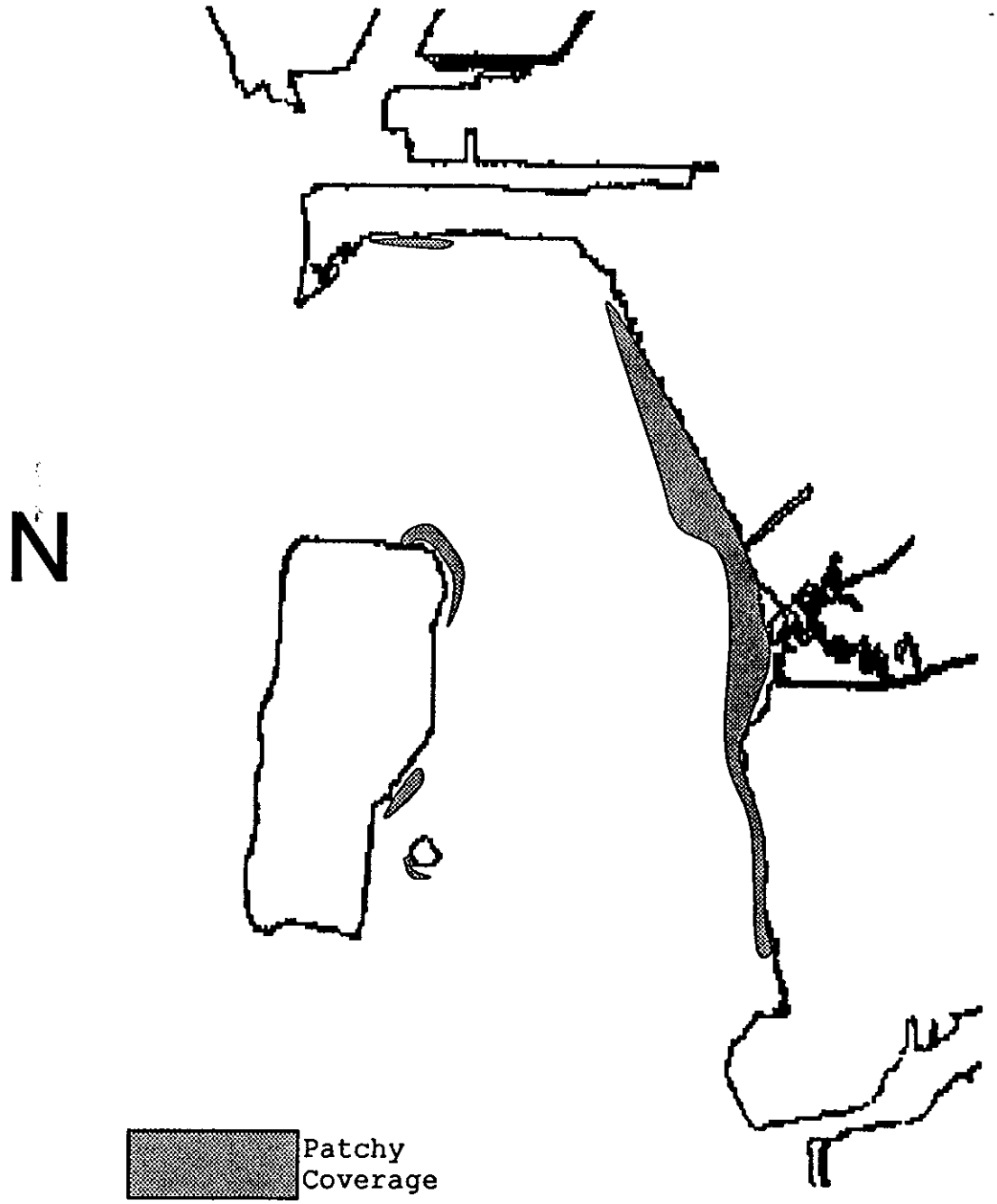

Figure 4. Distribution of *Halodule wrightii* in northeastern Hillsborough Bay (areas 4, 5, and 13).

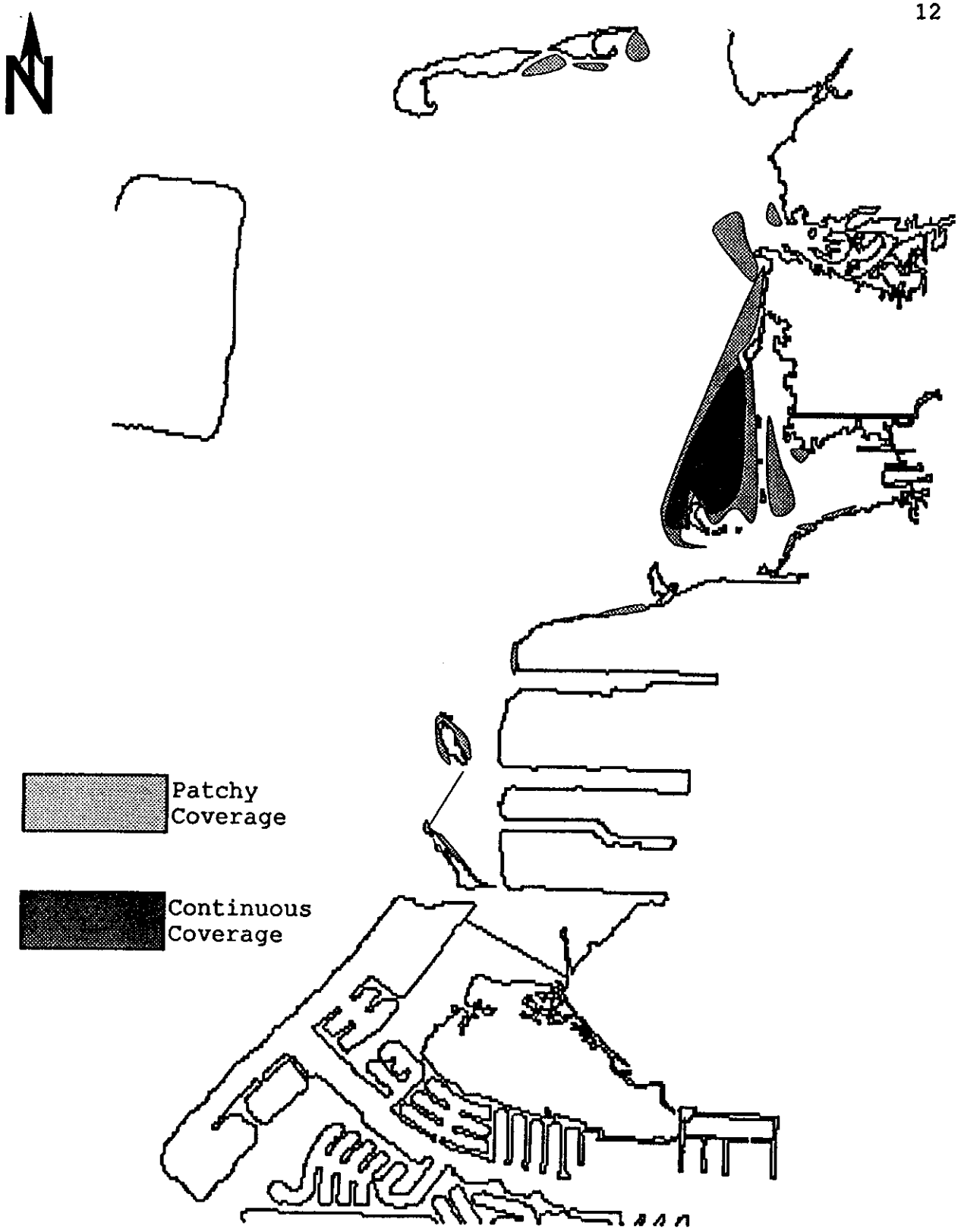

Figure 5. Distribution of *Halodule wrightii* in southeastern Hillsborough Bay (areas 1, 2, and 3).

Figure 6. Distribution of *Halodule wrightii* in northwestern Hillsborough Bay (areas 7, 8, and 9).

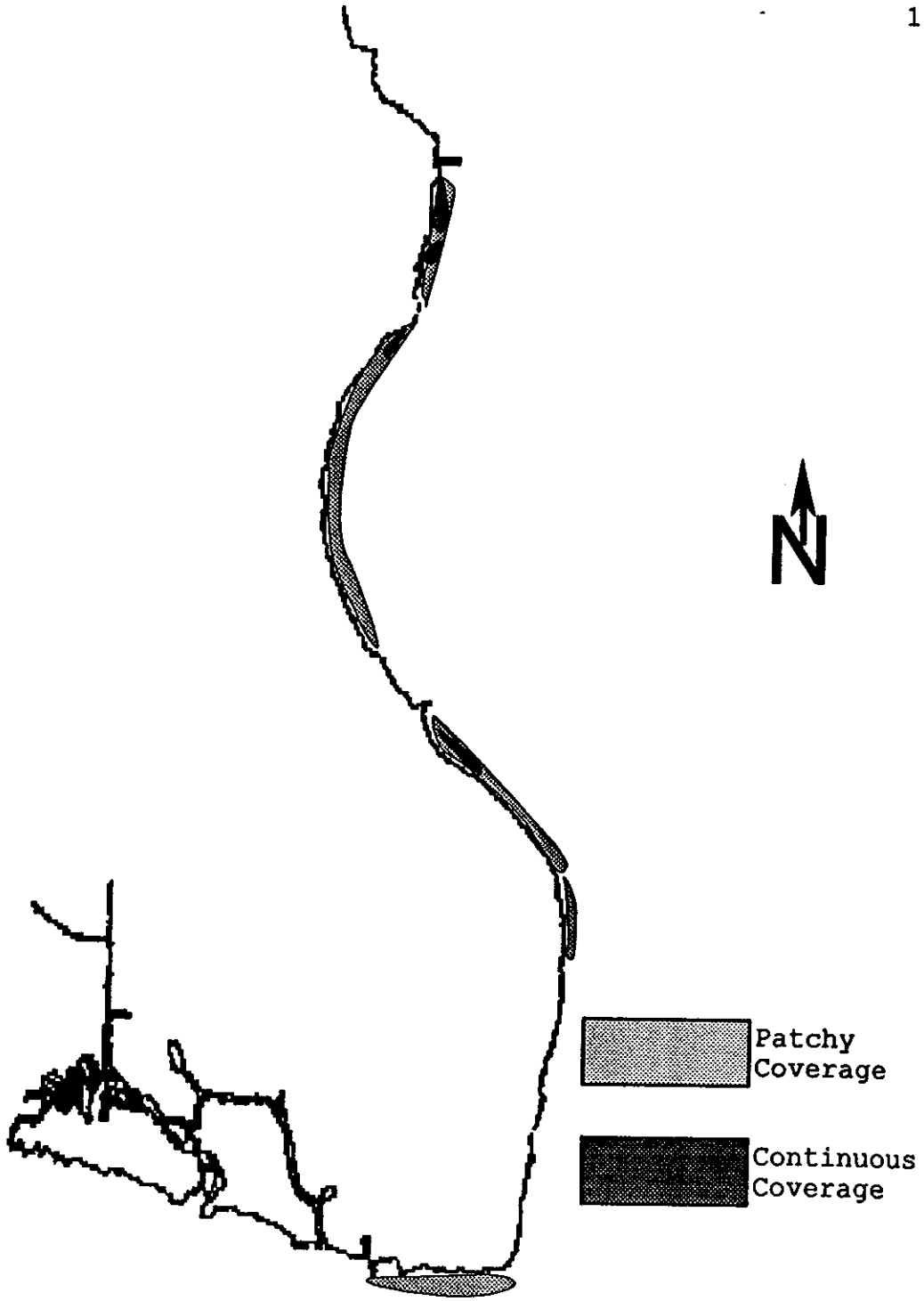

Figure 7. Distribution of *Halodule wrightii* in southwestern Hillsborough Bay (areas 10, 11, and 12).

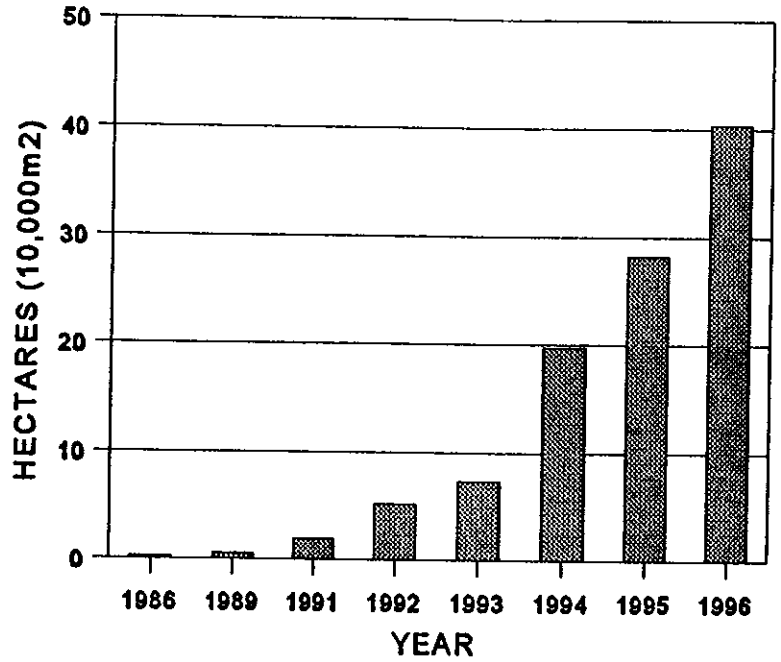

Figure 8. *Halodule wrightii* coverage in Hillsborough Bay.

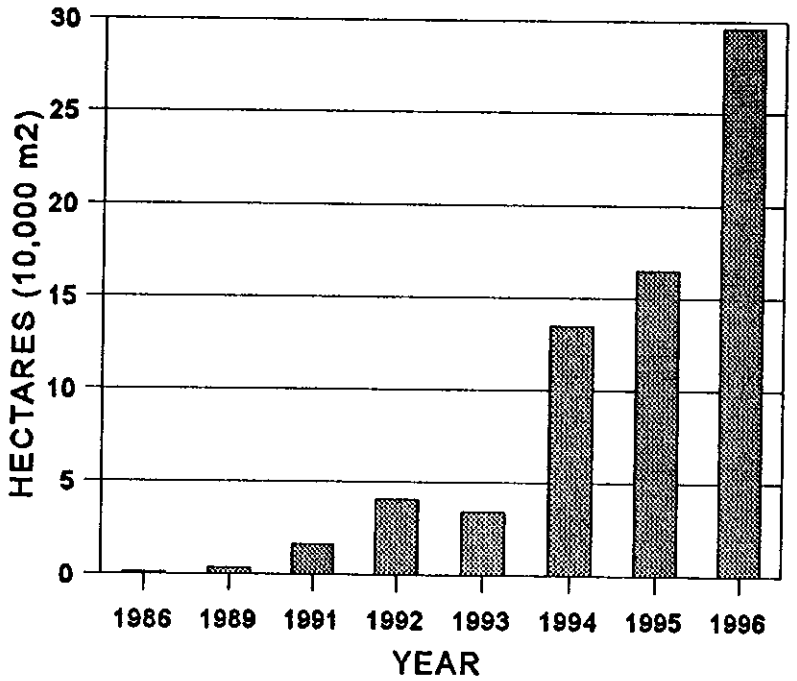

Figure 9. *Halodule wrightii* coverage in area 2.

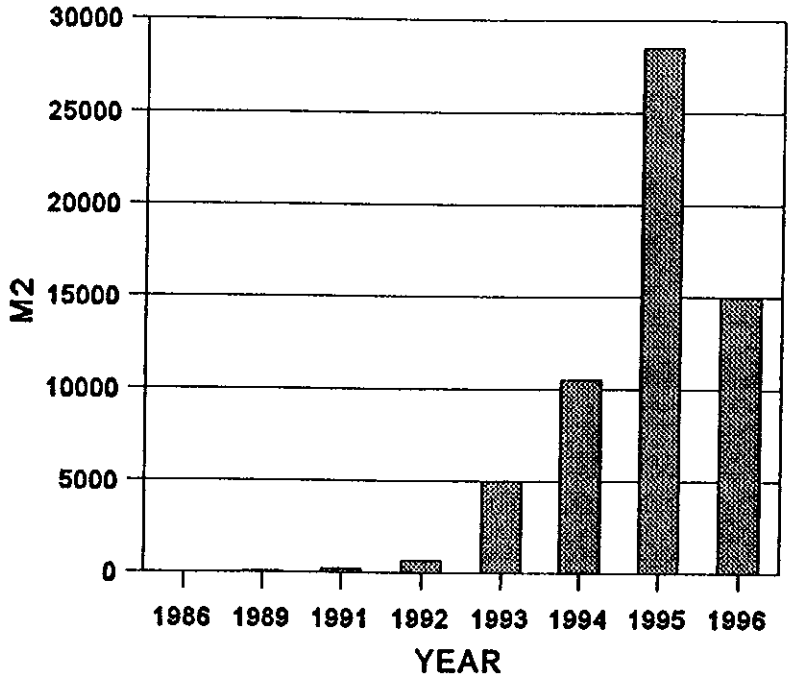

Figure 10. *Halodule wrightii* coverage in area 11.

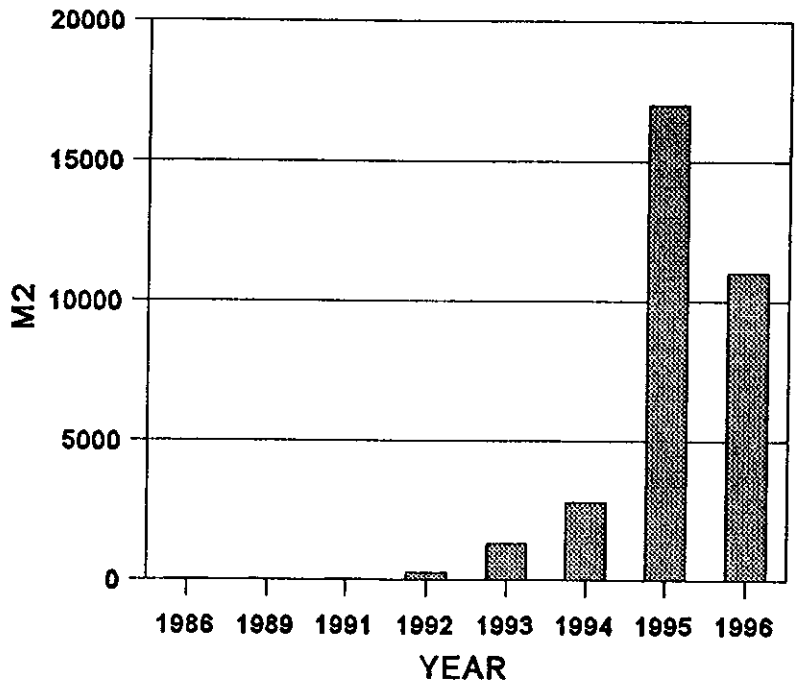

Figure 11. *Halodule wrightii* coverage in area 12.

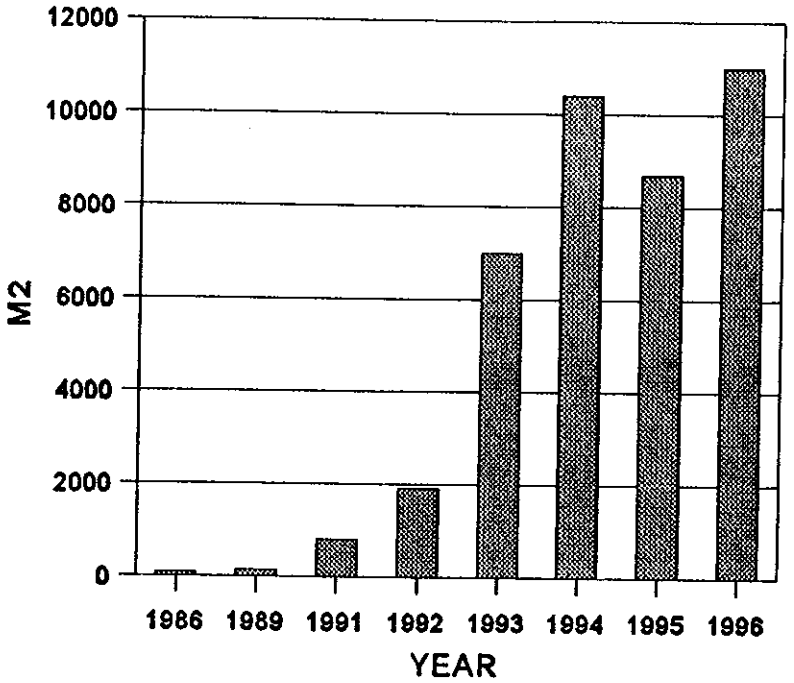

Figure 12. *Halodule wrightii* coverage in area 9.

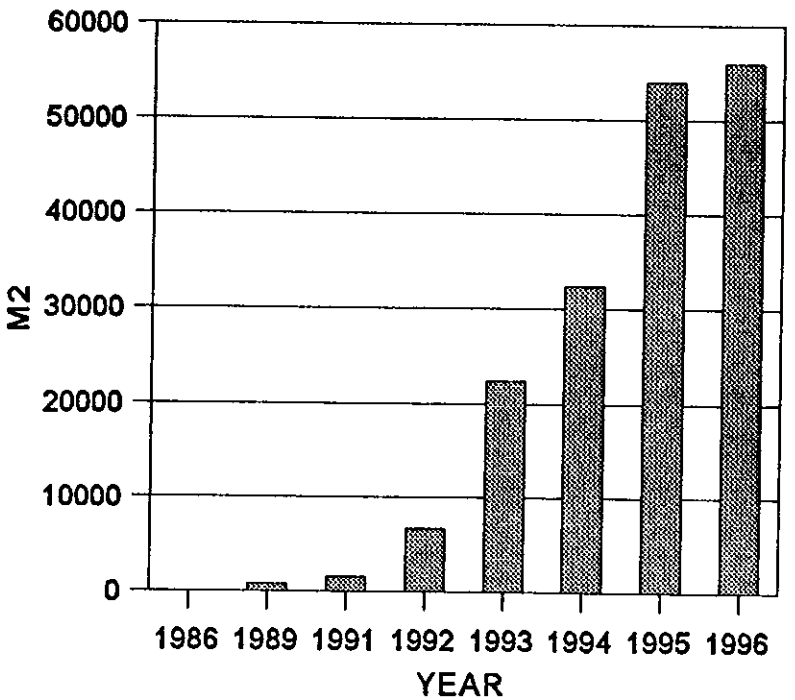

Figure 13. *Halodule wrightii* coverage in area 10.

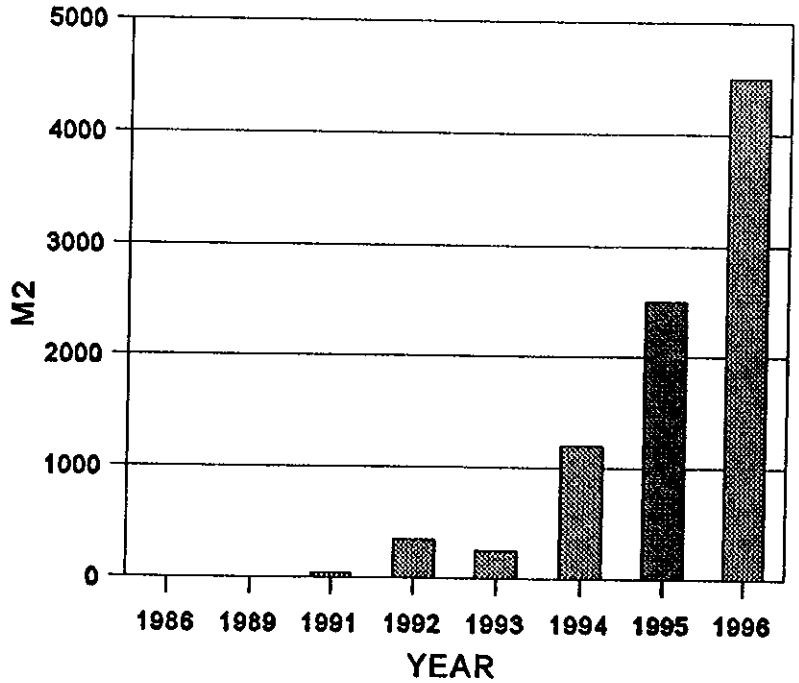

Figure 14. *Halodule wrightii* coverage in area 3.

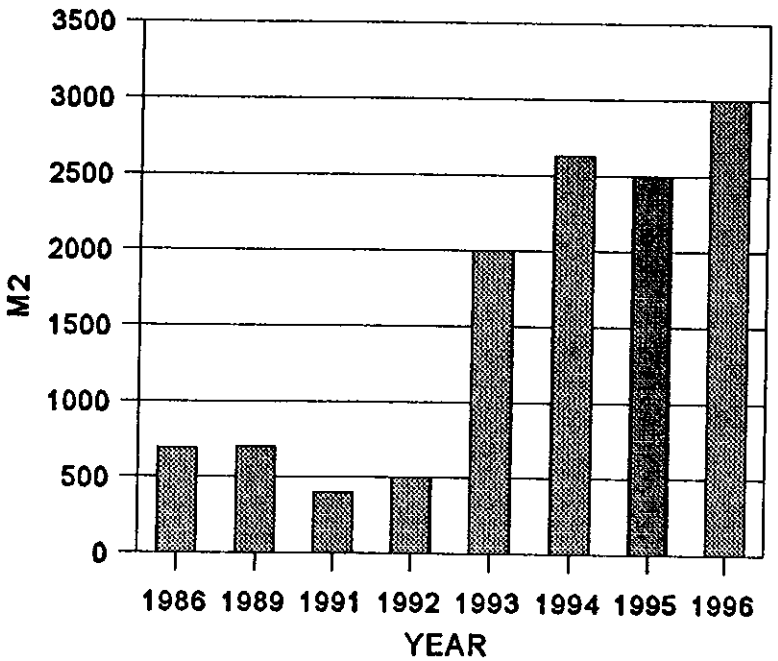

Figure 15. *Halodule wrightii* coverage in area 1.

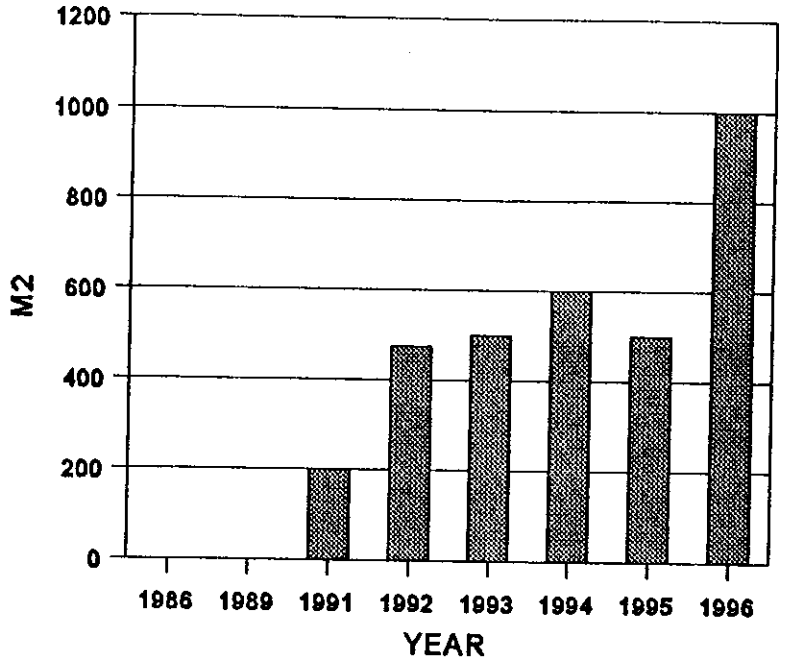

Figure 16. *Halodule wrightii* coverage in area 4.

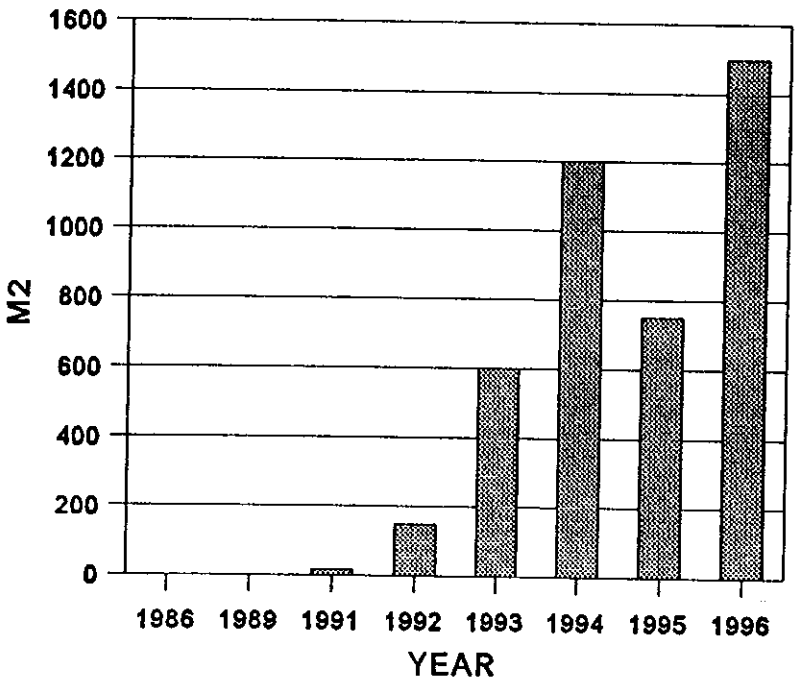

Figure 17. *Halodule wrightii* coverage in area 5.

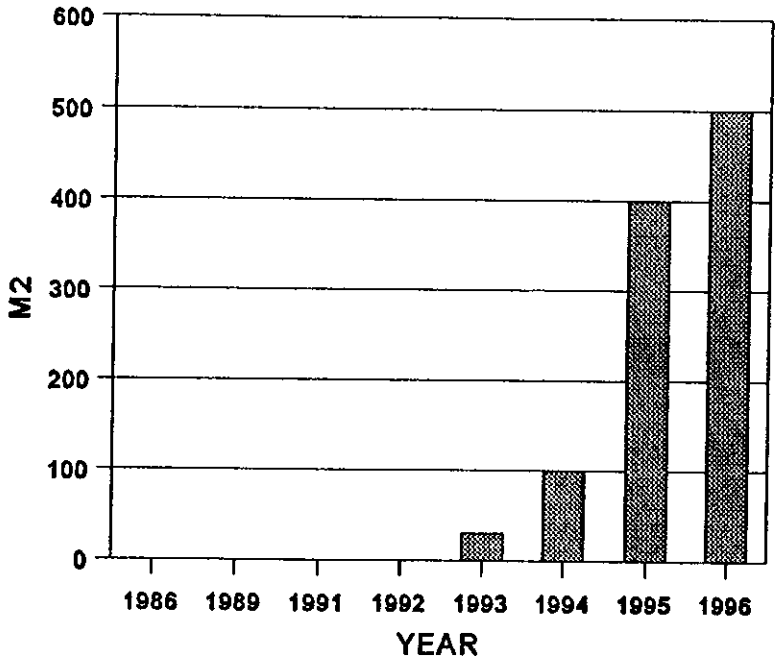

Figure 18. *Halodule wrightii* coverage in area 13.

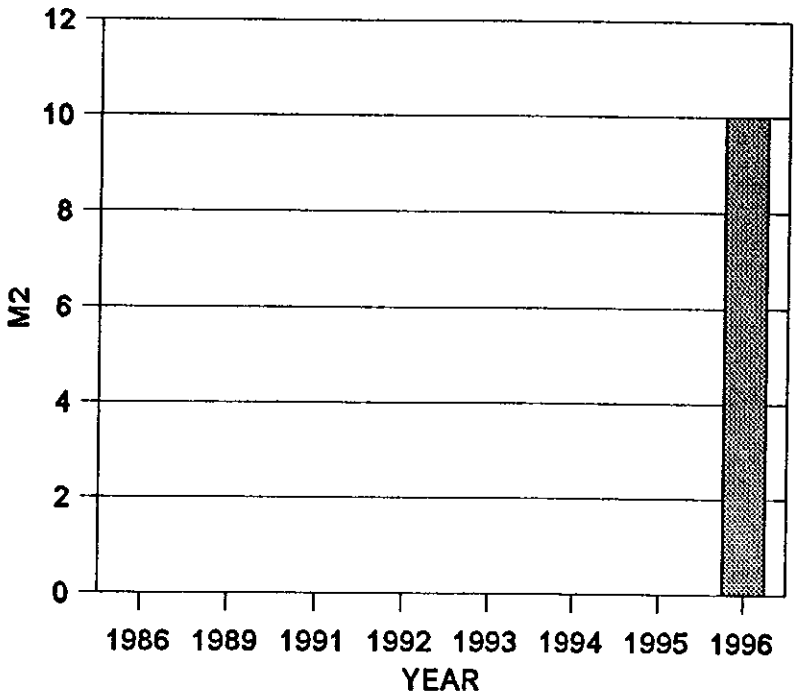

Figure 19. *Halodule wrightii* coverage in area 8.